KNOWLEDGE MANAGEMENT IN THE FOOD SUPPLY CHAIN

Dr. Carlos RODRIGUEZ MONROY; Dr. Joaquín FUENTES-PILA

Food Quality Engineering Research Group

Technical University of Madrid.

crmonroy@etsii.upm.es; joaquin.fuentespila@upm.es

Ing. Moisés E. MARTÍNEZ SOTO MSc; Dra. Julia VELASCO e Ing. Anne MORRIS MSc

Coordinating Unit Joint Projects
University of Zulia

moises.martinez.soto@alumnos.upm.es, jtvelasco@cantv.net , annemorrisdiaz@hotmail.com

Paper prepared for presentation at the 3rd International European Forum on

'System Dynamics and Innovation in Food Networks',

Innsbruck-Igls, Austria,

February 16-20, 2009

ABSTRACT

The object of the present article is to discuss Knowledge Management (KM) in the Agrifood Supply Chain (*ASC*). In the 21st century, the *ASC* is under strong tensions. This is evident in the drastic changes in the global scene. For example, in the year 2008, food prices were high and unstable. In the last years, the importance of knowledge as a source of competitive advantage for organizations has increased considerably, so it is necessary its management in the *ASC* in order to surpass the challenges of the 21st century. KM is a direction tool that focuses in determining, organizing, directing, providing and supervising the practices and activities related with the knowledge (intangible active) required to achieve the strategies and objectives of the business or industry, generating a value for the organization at the moment to reach capabilities and competences. In inter-organizational environments, KM is centered on horizontal alliances between two or more partners. However, there are few authors who have analyzed the vertical alliances between suppliers and customers (the supply chain).

The existing KM models are applicable for the *ASC*, as long as a series of conditions are present in the same one. Among these conditions there is one which prevails: The different enterprises that integrate the *ASC* must coordinate themselves in order to constitute a dynamic network, in which learning barriers are eliminated, so knowledge can flow freely through them.

In conclusion, the development of *KM* models in the *ASC*, in the framework of untimely, temporary and structural changes in the globalised world, represents a necessary tool to offer safety and quality food to the world-wide population in the 21st century. In this way, food markets will tend to become stabilized in the long term and adequate answers can be provided to the more vulnerable communities and regions.

Keywords: management, knowledge, agrifood supply chain, price stability

INTRODUCTION

The object of this article is to present some ideas about knowledge management in the food supply chain.

At present, the food supply chain is being submitted under great pressures due to the following factors:

• An increase in the human and animal world population, with a significant increase in food demand.

• An increasing in the demand of raw material of agricultural origin (RMAO) to be used as power sources. This applies mostly to cereals and oilseeds.

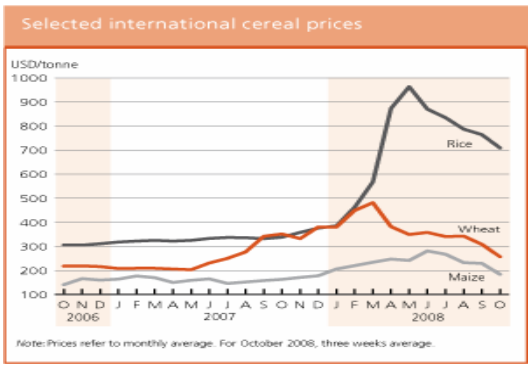
• Finite natural resources, that are vulnerable and in a degradation process.

• Sensitive public opinion and technical and legal regulations related to the production methods, industrialization, commercialization and food quality.

• Globalization and market instability.

These tensions were evident in the drastic changes of global scenarios as shown in Figure 1.

Figure 1 Evolution of international prices of major cereals



Source: FAO, 2008

In June 2008, a “High-Level Conference on World Food Security” was held in Rome to discuss the Challenges of Climate Change and Bioenergy in order to confront the food crisis

of the moment due to the unusual rise of food prices. In November 2008, in Washington DC the G-20 issued the “Declaration of the Summit on the Financial Markets and the World Economy” that made reference to “the serious problems that affect the world economy and the financial markets” (The White House, 2008), which has forced international food prices to drop sharply.

Nevertheless and beyond, the present global economic situation for the 21st century the majority of the experts came to the agreement that for the year 2000 increase the population to 6000 million inhabitants, and that at least it will increase to 7600 millions for the year 2020. This population increase 26.66%, but it is probable that the demand for cereal, which provides 70% of the world food, will increase between 40 and 50% (Borlaug and Dowswell, 2002). This is because of the increasing requirements for meat and milk, that will constitute a 35% of the increase in the demand of these crops between 1997 and 2020 (Pinstrup-Andersen and Pandya-Lorch, 2001) headed by corn in developing countries.

However, the previous forecast about the increase of the world demand for food seems to be too conservative, considering the combination of high oil prices and the generous subsidies of the government of the United States of North America, that has pushed the demand for ethanol obtained from corn as a power source. The enormous volume of corn required by the ethanol industry is provoking a shock through the world agrifood system (Runge and Senauer, 2007).

According to the Renewable Fuels Association (2008), at the end of 2006 there were 110 ethanol refineries in operation in the United States, many of which were in an expansion process, and other 73 were being built. When those projects are completed, in the first decade of the 21st century, the capacity of ethanol production in the U.S. will reach 11,400 million gallons per year.

Analyzing the case of corn (*Zea mayz* L.), the demand has increased 13.99%, from 686 MM metric tons in 2005 to 762 MM metric tons in 2008 (MAPA, 2008). International prices in 2005 were 125$.MT^{-1}, in 2008 they reached 247$.MT^{-1} (FEDEAGRO, 2008) which represents an increase on their nominal value of 97, 60%.

In the case of rice and wheat the increase was significantly higher 550$.MT^{-1} and 450$.MT^{-1} the increase was over 100% in a year as shown in Figure 1.

In the short term, the impact of food price increases differed between countries and socioeconomic groups. At a country level, on one hand, those that are food exporters benefitted the trade improvement, although some of them did not gain all of these benefits as a result of confluent between the government and the productive sector due to the export (Argentinean Case) or to the restriction derived from to export quotas. On the other hand, the importing countries try to satisfy their domestic demand for food. Almost all the African countries and some of the Latin America countries, such as Venezuela, are net food importers, so they were seriously affected by the price increase.

At a family level, food price increases have negatively impact in those with a lower purchasing power that means poor people and in those who are more exposed to food security of supply. For the future, the impact is unpredictable; although measures have been announce to confront possible increments of food prices, which indicate that it is not right to balance the prices of food with general macroeconomic measures (Von Braun, 2008).

Among these measures it is possible to include the following: to extend the social protection in those countries with more vulnerable populations; to reform the commercial policies and subsidies that allow developed countries to review their policies related to biofuels and agricultural trade, and to help the developing countries to stimulate the production and to correct the distortions of imperfect markets and to invest in post-harvest agriculture management, industrialization and food distribution in the frame of a sustainable rural

development with emphasis in agricultural technology and science. In this last case, the efforts should concentrate in improving the efficiency of the supply chain of the agrifood industry and in obtaining one or more cultures bases of not food counterfoil for the development of the agro- energetic industry (second and third generation biofuels). If in the 20th century, the agrifood industry was capable, in reasonable terms, to give an answer to the increase of the world demand for food as a result of the population growth; in the 21st century the challenge is superior because it has to supply food for the population and raw materials to the agro-energetic industry, practically with the same quantity of natural resources but in very fragile conditions, in a more exigent context and in a more sensitive public opinion. This challenge can only be overcome through the development of scientific knowledge, technological innovation and knowledge management in the supply chain of food and raw materials of agricultural origin.

The previous tensions could verify the fatalistic projections of some thinkers, such as Thomas Robert Malthus (1766 - 1834) who indicated that: *"the humanity will arrive to a point in history in which it will not find enough resources for its subsistence"* and so *"it seems that the population has achieved a risky balance in which any small deficiency in available food turns out in terrible hunger"* in front of this reality, different questions arise such as:

Are the rising prices and the instability in the international market of food and raw materials of agricultural origin temporary or permanent? Will the development of knowledge be able to generate the necessary equilibrium to reach food security and quality?

DEVELOPMENT

The management of knowledge:

In the 21st century the capital, the work, and the land have left being the basic production factors and it is knowledge and information that serve as the main support for industrial activity and the most important potential factor for changes in the forms of development of companies (Muñoz, 1999).

The importance of knowledge, as a source of competitive advantage for the organizations has increased considerably (Salazar, 2004). Knowledge has been described as one of the most valuable resources of the society (Davenport & Prusak, 1998; Holsapple & Joshi, 2002; Martinez Caraballo, 2006; Nonaka and Takeuchi, 1995; OECD, 1996; Kings, 2005), that contributes to efficiency improvement of the organizational methods of goods and services production (Wiig, 1997), so, it is necessary its management in the food supply chain, in order to surpass the challenges of the 21st century.

In that sense, *KM* is a tool that focuses in determining, organizing, directing, providing and supervising the practices and activities related to knowledge (intangible active) required to reach the strategies and objectives of the business or industry that generates value for the organization at the moment of obtain capabilities and competences (Holsapple & Joshi, 1999).

KM has been described as an art which transforms intellectual information and intellectual actives in a durable value for an organization and its customers. It is like a process that uses information technologies in a powerful combination for data treatment along with information, creative and innovative capacity of the human beings in a complex group of dynamic abilities and *know-how* that is a constant change. (Bueno, 1999; Firestone & McElroy, 2003; Reyes, 2005; Wiig, 1997).

The study of the *KM*, has been evolving and maturing on the basis of the development of models, that could be classified as descriptive models (that characterize the nature of the phenomenon) and prescriptive models (that indicates the methodology that must be followed for *KM*), which are being validated in the own conceptual, methodological and operational dynamics, in different sectors of goods and services production.

Among the most studied *KM* models (Marin-García, and Zarate-Martínez, 2008) the following are included:

1. Descriptive models:
    - 1.1. Kart Wiig´s Pillars Model
    - 1.2. Leonard-Barton´s Capacities Model
    - 1.3. Model of Organizational KM by Arthur Andersen and The American Productivity and Quality Center
    - 1.4. Model of Intelligent Organization by C. Choo
    - 1.5. Model of the four stages of KM. by Van der Spek y Spijkervet
2. Prescriptive models:
    - 2.1. Model of the intangible assets, Sveiby
    - 2.2. Model of the Intellectual Capital, Petrash
    - 2.3. Model of creation of organizational knowledge, Nonaka and Takeuchi
    - 2.4. Model of Transference of Knowledge, Gabriel Szulanski
    - 2.5. Model of the Process of *KM*, KPMG
    - 2.6 Participating model of *KM*, Holsapple and Joshi
    - 2.7. Model of Rastogi.
    - 2.8. Integral model of *KM* by Beijer
    - 2.9. Model of flow of the Knowledge by Heisig

2.10. Model Building Blocks of Knowledge Management, by Probst, Raub and Romhardt

2.11. Model of the Cycle of the Knowledge by Mc Elroy

Nevertheless, in spite of all these advances in the study of KM the development of new models, applied to the agrifood supply chain is needed. It is one of the main actions needed to reach the strategic levels of food sustainability, required by the humanity in the 21st century.

In this context, *KM* constitutes the assertive handling of the intellectual capital to manage the different links in the supply chain in the fulfillment of the multifunctional character of food security. That means, producers, processors, dealers and other instances of support and services add availability, quality, continuity, innocuity and reasonable costs (access) based on the satisfaction of the needs of nourishment of the population.

In inter-organizational environments, the literature related to KM, it is centered on horizontal alliances between two or more partners. However, there are few authors who have analyzed the vertical alliances between suppliers and customers (the supply chain). Regardless of the type of collaboration established, research indicates that a great number of inter-organizational relationships fail (Capó et al, 2005). Whatever type of collaboration might be established that settles down, the studies performed indicate that a great number of inter-organizational relations fail (Capó et al, 2007).

The Agrifood Supply Chain (*ASC*)

The *ASC* is defined as a complex sequence of process of exchange or material and information flow that it is established within each organization or enterprise, as well as with its respective suppliers and clients (Christopher, 1998). Knowledge management (*KM*) has a great applicability in the agrifood supply chain (*ASC)*. In the *ASC* exists different relationships typologies from strictly commercial relationships until vertically integrated (Lambert et al, 1996) with diverse degrees of collaboration between the vertical integration

participants of the same one. In purely commercial relationship, knowledge is transferred between companies that participate in the project through intermediaries. Whereas, in order to have a successful alliance, the relationships are transformed through investments in particular assets, recombination of capacities and routines, distinctive developments of *know-how*, establishing common experiences and practices and developing a new common language, that facilitates cooperation. These mechanisms support the transfer and recombination of knowledge (Ciborra and Andreu, 2001).

The following common typologies are related to the *ASC*:

The Autonomous Network which is predominantly characterized by the informal relationships between companies without a contract, establishing a conduct code that governs the Network.

According to Moller, et al (1998), ***The Extended Enterprise*** is a group of institutions that develops links, shares knowledge and resources and collaborates to create a product and/or service. It is characterized by the presence of a dominant company that extends the vision and influence of its operations to a Network, leading it and determining its operation. Within the Network the relationships between their members are perfectly structured and respond to formal agreements.

According to Preiss and Murria (2005) a ***Virtual organization*** is a set business units, in which the personnel and the processes of work of the different business units interact intensively, in order to reach results that benefit them. The virtual organization includes diverse forms, from Strategic Alliances to Joint Ventures.

The Virtual Enterprise is characterized (Hayfron et al, 1998) by the complementary contributions that offer the different companies that integrate it, where one of them represents the principal direction (broker); its function is to explore new markets and to adopt an organizational structure to satisfy its needs.

Among the common characteristics of these organizations we should mention that they are directed by strategic plans of agreement and they are structured through the human teams of each participating company, being supported by the development of the information and communication technology (*ICT*). This situation allows eliminating the need for physical dependency of the members of the different teams. At the same time, those tools allow the interaction of the teams and make it possible to solve problems within the chain.

Conditions for the Application of the Knowledge Management in the Agrifood Supply Chain.

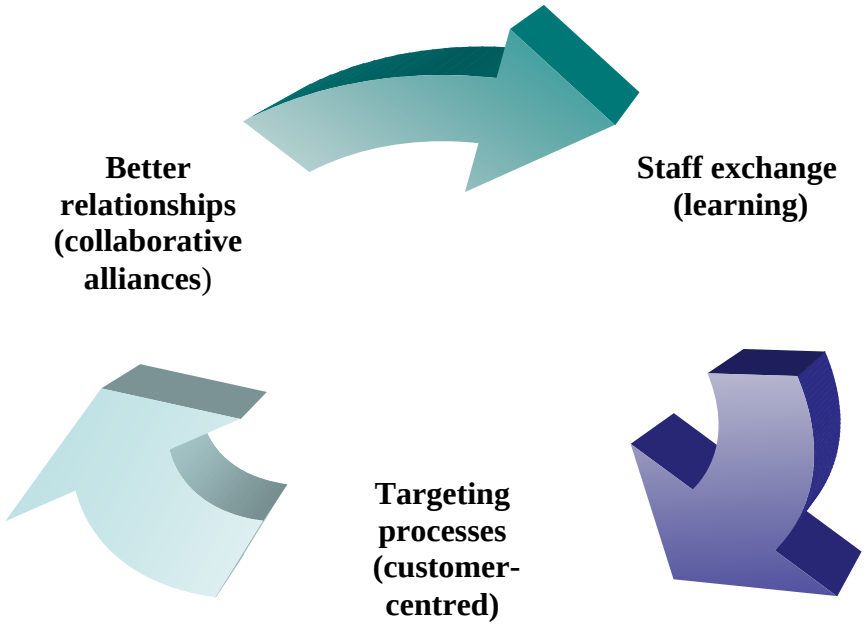
The 20th century left learned lessons, particularly, in the management of the tense equilibrium between the demand and supply of food. This *KM* refers to the increasing and optimization of the yields of the different productive systems and agro-alimentary production chains using new techniques and practices, in order to improve the farming and the processes of post-harvest, industrialization and distribution of foods. These results are due to the change of the structure of the development of diverse approaches of human knowledge, such as: Institutional changes, human capital, the appropriate practices and the adaptive invention. In this sense, *KM* represents a way to integrate in a single process all these different approaches. Also, from the literature review we observe that the existing *KM* models are pertinent to *ASC*, as long as a series of conditions occurs. These conditions are added in a single condition, the enterprises that integrate *ASC* should be structured to represent a dynamic network, in order to eliminate the barriers of learning so that knowledge flows freely among them (Hood et al, 2007). To this end, the use of the information and communication technologies is a good opportunity, through concepts and virtual enterprises.

The *ICT* enables communication among participants in the *ASC*. This communication allows, on the one hand, a greater efficiency in the team work of the enterprises geographically dispersed (minimizing the impact of distance), on the other hand, it improves the processes

for continuous formation in the organizations facilitating the culture based on strategic learning, to secure competitive advantages, what is called *"learning organization"*. This process is a previous step to the implementation of *KM* models, it is said, it implies the administration of a certain process in order to facilitate the knowledge that is known in an enter conscious or unconscious form and the knowledge that is needed to transform all this in actions oriented to achieve the specific objectives linked whit the creation of value, in this case offering to consumers quality and food security.

Also, three key factors have been identified to explain successfully the concepts of *KM* in *ASC*: better relations (collaborative alliances), exchange of personnel (learning), and direction by processes (centered in clients) (Figure 2).

Figure 2: Dynamic cycle in order to manage the knowledge in the supply chain



Source: Hong et al, 1999

Some experiences of the application of the Knowledge Management in the food supply chain in Latin America.

Although historically knowledge has been managed in the food supply chain, it is now with the development and massification of the major possibilities of applying and of optimizing the concepts and the methods of *KM* in the agro-alimentary industry are open.

In the work experience of this first decade of the 21st century, *KM* is mixed and is frequently used with the *ICT*, systematization, evaluation, qualification and formation, creation of data bases, electronic information systems, and forums among others, because it is considered important to have a discussion in a regional level about *KM* and its practice in Latin America. (Camacho, 2008).

There are two Latin American experiences that try to apply the concept *KM* in the rural development with base on the agro-alimentary production and its supply chain, using the *ICT*.

Name of the project	Sponsors Institutes	Object	Country Involved
Latin-American Platform of *KM* (ASOCAM) http://www.asocam.org/index.shtml	Switzerland Agency for development and cooperation	Promote *KM* Important Topics for rural development of the region	50 places located in : Bolivia, Cuba, Ecuador, El Salvador, Nicaragua, Honduras , Peru , Switzerland
Network of Agricultural Innovation Project	Joint Initiative of the Switzerland Agency for the Development and Cooperation of COSUDE and of the Inter American Institute of Coorporation for Agriculture (IICA)	To organize, to promote and to facilitate the access to the information and the knowledge appropriated to the different actors of the agrifood chains involved in the project	American Central System of integration of Agricultural Technology (SICTA),Technological arm of The Ministers of Agriculture meeting in the Latin American agricultural cabinet

Source: Compiled by Martínez et al 2009

CONCLUSION

The development of *KM* models, in the *ASC*, within the temporary and structural changes of the globalised world, represents a necessary tool to offer food security and food quality to the world population in the 21st century. In this way, the food markets, in the long term tend to become stabilized and they will also offer answers to the more vulnerable regions and communities.

The situation of instability of the food market during 2008 serves as reminder of the fragility of the balance between the world-wide food provision and the needs of the world population.

The quality warranty and food security for the consumers and population generally happens through the development of new approaches in the management of the food supply chain, in which knowledge is considered the determining factor for value creation.

For that reason, it is required to increase the level of trust and communication between the different links from this supply chain, whose technical, legal and market requirement, as well as those derived from public opinion are greater, because the investments necessaries to reach the demanded standards must be proportionate to the benefits expected by all the participants in the supply chain including producers and consumers.

Only in this way, it is possible to reach the strengthening, of the food supply chain and to obtain strategic levels of competitiveness and sustainability required by different companies that integrate the *ASC*.

REFERENCES

1. ASOCAM (2009), Plataforma latinoamericana de gestión del conocimiento. Available at: http://www.asocam.org/index.shtml
2. Borlaug N. E., Dowswell C. R. (2002), “Perspectivas de la agricultura mundial para el siglo XXI”. Costa Rica. Manejo Integrado de Plagas y Agroecología No. 65 p. 4 – 20.

3. Bueno, E. (1999), "La Gestión Del Conocimiento En La Nueva Economía." 15-19 in Gestión Del Conocimiento y Capital Intelectual. Experiencias En España, Bueno, E. Madrid: Universidad Complutense de Madrid (Curso de Verano, San Lorenzo de El Escorial, 1999).
4. Camacho, K. (2008), Gestión del Conocimiento: aportes para una discusión Latinoamericana. Knowledge Management for Development Journal 4(1): 31-41 Available at: www.km4dev.org/journal
5. Capó, J., Expósito, M. y E. Masiá (2005).La Gestión del Conocimiento en las redes de PYMES. El caso del cluster textil valenciano, Revista de Economía industrial, 355, 305-315
6. Capó, J. Tomas-Miquel, J. V. y Exposito-langa, M.. (2007), "La Gestión del Conocimiento en la Cadena de Suministro: Análisis de la Influencia del Contexto Organizativo." Inf. tecnol., 2007, vol.18, no.1, p.127-136. ISSN 0718-0764.
7. Christopher, M., (1998), "Logistics and Supply Chain Management. Strategies for reducing cost and improving service." Prentice Hall. Londres,
8. Ciborra, C.U. y R. Andreu (2001), "Sharing knowledge across boundaries", Journal of Information Technology, 16, 73-81
9. Davenport, T and Prusak, L. (1998), "Working Knowledge: How Organizations manage what they know." Cambridge, MA: Harvard Business School Press.
10. Food and Agriculture Organization of the United Nations FAO (2008), "Perspectivas de cosechas y situación alimentaria. No. 4." Octubre 2008 citado 29 Diciembre 2008. Available at: ftp://ftp.fao.org/docrep/fao/011/ai473s/ai473s00.pdf (10/01/09)
11. Confederación Nacional de Asociaciones de Productores Agropecuarios de Venezuela FEDEAGRO (2008), Precios internacionales de productos agrícolas.. Available at: http://www.fedeagro.org/preciointer/precioanual.asp (13/05/08).

12. Firestone, J. and Mcelroy, M. (2003), “Key Issues in the New Knowledge Management.” Burlington.: Knowledge Management Consortium International.
13. Hayfron, L.E., Carrie, A.S., Bititci, U.S. y K. Pandya, “Manufacturing Franchising and Enterprise Networks.” En Bititci, U.S. y A.S. Carrie (ed.): Strategic Management of the Manufacturing Value Chain. Kluwer Academic Publishers, Dordrecht (1998).
14. Holsapple, C.; Joshi, K. (1999): "Description and Analysis of Existing Knowledge Management Frameworks". Proceedings of the 32nd Hawaii International Conference on System Sciences.
15. Holsapple, C.; Joshi, K. (2002), “Knowledge Management: A Threefold Framework.” Information Society, 18 (1): 47-64.
16. Hong-Minh, S.M., R. Barker y M.M. Naiim (1999), “Construction supply chain trend analysis.” Seventh Annual Conference of the International Group for Lean Construction (IGLC-7), Berkeley.
17. Lambert, D.M., M.A. Emmelhainz y J.T. (1996), “Gardner *Developing and Implementing Supply Chain Partnerships*.” International Journal of Logistics Management 7(2) 1-17.
18. Malthus T. R. (1798), “Limitaciones del Desarrollo de la Población.” INEP Internet para el profesional de la política. p 8. Available at: http://inep.org/index2.php?option=com_content&do_pdf=1&id=3299 (01/09/08).
19. Ministerio de Agricultura, Pesca y Alimentación de España MAPA (2008), “Mercado mundial de cereales.” Available at http://www.mapa.es/ministerio/pags/observatorio/pdf/precio_cereales/mundial_cereales_07.pdf (13/05/08).
20. Marin-Garcia, J.A.; Zarate-Martinez, M.E. (2008), "Propuesta de un modelo integrador entre la gestión del conocimiento y el trabajo en equipo". Intangible Capital, 2008, vol. 4, núm. 4, p. 255-280

21. Martinez, N. (2006), “Knowledge Management: Individual Versus Organizational Learning.” Intangible Capital, 2 (3): 308-326
22. Moller, C. J.O. Riis y M. Hansen, (1998), “Interorganisational network classification. A framework for studying industrial networks.” U.S. Bititci, A.S. Carrie (Edits.) Strategic Management of the Manufacturing Value Chain, Kluwer Academic Publishers.
23. Muñoz J. (1999), “Sobre gestión del conocimiento, un intangible clave en la globalización.” Economía industrial, ISSN 0422-2784, Nº 330, 1999, pags. 61-70
24. Nonaka, I.; Takeuchi, h. (1995), “The Knowledge Creating Company. How Japanese companies create the dynamics of innovation.” NY Oxford University Press.
25. Organisation for Economic Co-Operation and Development OECD (1996), “The Knowledge Based Economy.” GD (96)102. Head of Publications Office. Paris.
26. Pinstrup-Andersen; Pandya-Lorch, R. Eds. (2000), Unfinished Agenda: Perspectives on Overcoming Hunger, Poverty, and Environmental Degradation. Washington DC, IFPRI.
27. Preiss, K.J. y P.A. Murria (2005), “Fashions of learning: improving supply-chain relationships.” Supply Chain Management: An International Journal, 10 (1): 18-25
28. Proyecto Red de Innovación Agrícola Red SICTA (2009), Available at http://infoagro.net/infotec/central/index.html
29. Reyes, C. (2005), Analysis of the Relation Between Knowledge Engineering and Knowledge Management Based on the Nonaka and Takeuchi Models. Intangible Capital, 1 (3): 1-15.
30. Renewable Fuels Association. Available RFA (2008), at http://www.ethanolrfa.org/ (30/08/2008)
31. Runge C. F. and Senauer, B. (2007), “How Biofuels Could Starve the Poor.” Council on foreign relations, from Foreign Affairs, May/June 2007.

32. Salazar, J. M. (2004), “Algunas Reflexiones Sobre La Gestión Del Conocimiento En Las Empresas.” Intangible Capital, 0 (1): 1-6.
33. The White House (2008), Declaration of the Summit on Financial Markets and the World Economy. Citado 29 Diciembre 2008. Available at: http://www.whitehouse.gov/news/releases/2008/11/20081115-1.html (20/01/09)
34. Von Braun, J. (2008), “El aumento en los precios de los alimentos ¿Qué hacer?” International Food Policy Research Institute IFPRI. Perspectiva de Políticas Alimentarias.
35. Wiig, K. (1997), “Knowledge Management: An Introduction and Perspective.” Journal of Knowledge Management, 1 (1): 6-14.